VOLUME 80 SEPARATE No. 452

PROCEEDINGS

AMERICAN SOCIETY
OF
CIVIL ENGINEERS

JUNE, 1954

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Presented at
Atlantic City Convention
June 14-19, 1954

SANITARY ENGINEERING
DIVISION

{Discussion open until October 1, 1954}

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Printed in the United States of America

Headquarters of the Society
33 W. 39th St.
New York 18, N. Y.

PRICE $0.50 PER COPY

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This paper was published at 1745 S. State Street, Ann Arbor, Mich., by the American Society of Civil Engineers. Editorial and General Offices are at 33 West Thirty-ninth Street, New York 18, N. Y.

USE OF DELAWARE RIVER WATER THROUGH THE DELAWARE AND RARITAN CANAL

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SYNOPSIS

Local use of the Delaware River for water supply is made at various points in New Jersey but the only present means by which Delaware River water can be utilized elsewhere in the state is through the Delaware and Raritan Canal, which was rehabilitated for this purpose by the State upon its abandonment as a traffic artery.

The water supplies of New Jersey have been a topic of interest for some time. For quite a few years past the total safe yield of public supplies, particularly in the northern metropolitan district, have barely exceeded the demand. Various plans for large developments have been proposed by far-seeing engineers and others, but since the completion of the Wanaque project in 1930, and a supplemental supply from the Ramapo River in 1953, none has reached the stage of authorization, with the exception of the Delaware and Raritan Canal.

Plans proposed for substantial increase in the water supplies of the State fall into two general categories, one being the development of resources lying entirely within the State, the other- the development of means with which to utilize a share of the water of the Delaware River basin which now passes the State largely wasted to the sea. The Delaware and Raritan Canal stands obviously as the most immediately available for use, and it is the purpose of this paper to describe the part being played by the Canal in contributing to the total water supply of the State of New Jersey.

This canal was chartered by the legislature in 1830 to make possible an inland water route for commerce between New York and Philadelphia. Construction was started immediately and the canal was completed and in operation in 1834. The route of the main canal runs for 43 miles from Bordentown through Trenton, Princeton, Bound Brook and New Brunswick along the valleys of Assumpink Creek, Stony Brook, the Millstone River and finally along the Raritan River. The Feeder carries water from a pool created by wing-dams in the Delaware at Bulls Island, 22 miles above Trenton, along a route generally parallel to the river until it empties into the summit level of the main canal at Trenton. The 15 foot fall from the Feeder intake to Trenton was controlled by three locks, providing for barge traffic from the Pennsylvania coal fields via the Pennsylvania barge canal, crossing the Delaware to a river lock at Lambertville. The fifty-five foot drop in the main canal from Trenton to the Raritan River at New Brunswick was controlled by seven similar structures, as was the arm from Trenton to Bordentown.

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The canal wherever possible was built as a "side-hill" project. A unique feature of construction was that all structures were built on timber grillage regardless of foundation conditions. The width of the main canal at water surface was about 80 feet, with a bottom width of 50 feet and a depth of 9 feet. The feeder was generally 50 feet wide at the surface, approximately 30 feet wide at the bottom with a depth of 6 feet. Locks on both feeder and main canal were 24 feet by 110 feet with 7.5 feet of water over the mitre gate sills.

The original cost was reported at somewhat over 3.7 million dollars, with an increase of one million for doubling the length of locks following peak operating conditions during the Civil War. At the same time the upstream mitre gates were replaced with drop gates. Feed to the locks was by gravity from the upper level through a battery of horizontal wickets adjacent to the drop gates, under which the water flowed into the lock, which was emptied through vertical butterfly wickets in the downstream mitre gates. In 1894, appreciably after the peak of operation, water use was reported[3] as ". . . 324 cubic feet per second being permanently diverted to supply the canal." However, of this amount half was returned to the Delaware at Bordentown and some 150 cfs, or 100 mgd, was permanently diverted from the watershed to supply canal requirements for evaporation, leakage, lockage and industrial use across the state.

In this connection it is worth noting that water was drawn from the canal for various uses from the start of operations. Water-use grants were made in some cases as part consideration for land taken for construction.

The canal failed to open for navigation after its winter shut down in 1933 and in 1934 the property was taken over by the State. Shortly thereafter the portion of the Bordentown arm of the main canal lying within Trenton was given to the city and filled in as a WPA project. (It has since been reexcavated to serve as the site for the depressed portion of the Trenton Freeway.) The present canal consists of the Feeder and the Trenton-New Brunswick section of the main canal as shown on the accompanying map.

Efforts were made to interest the Federal government in re-establishing the canal as a commercial waterway, but the proposal was finally rejected by Army Engineers in 1942, and a report concerning ultimate use was made to the New Jersey Legislature. The report considered all practicable possibilities. Abandonment, with attendant filling and disposition of local drainage, would have cost more than rehabilitation. The Highway Department was not interested in the property generally because of the comparatively narrow right-of-way in critical areas. The canal was obviously suitable for recreation but it was felt that such use alone would not justify the cost of repairs which had by this time become necessary for public safety regardless of use.

As previously noted, the canal had from its beginning supplied water to adjacent industries, and the water situation in New Jersey was becoming critical, with consumption in the metropolitan area already equal to the safe yield of developed sources of supply. The value of the canal and its diversion rights had been recognized in a report[4] by Governor Moore to the Legislature in 1939, which recommended enclosure of the canal in a twin conduit as far as Bound Brook, where the water would be pumped to a reservoir in Dock Watch Hollow,

3. Geological Survey of New Jersey, Vol. III of the Final Report of the State Geologist, 1894, by C. C. Vermeule M. ASCE, p. 228.
4. Special Message of A. Harry Moore, Governor of New Jersey, to the 163rd Legislature of New Jersey; Engineering Report by Chas. H. Capen, Jr., M. ASCE, H. T. Critchlow, M. ASCE and H. P. Croft.

thence flowing by gravity to the North Jersey metropolitan area. No action had been taken when this proposal was made and its estimated 45 million dollar cost apparently precluded such development in the near future.

However the canal was a ready-made source of industrial supply and such use would relieve to some extent the increasing demand on the scarce, and more expensive, potable supplies.

Recommendations were therefore made that the canal be rehabilitated as an industrial water supply and for supplementary recreational use. Legislation embodying the recommendations was passed and an initial appropriation was made in 1944.

Rehabilitation was started in the winter of 1944-45 with the dredging and sheet pile fluming of the Trenton "bottleneck," a constricted reach of Feeder about one mile long through the heart of the city.

The first control structure, a former lock at Raven Rock, 3/4 mile below the intake from the Delaware, was rebuilt with a reinforced concrete headwall and modern cast-iron sluice gates. Flood deposited silt, accumulated since its last cleaning in 1918, was dredged from the entire intake section.

The locks at Kingston and in New Brunswick, both major control points, were also rebuilt with concrete headwalls and cast-iron sluice gates, and the old masonry lock walls were gunited.

The old timber aqueduct near Princeton, which had originally carried the canal over the Millstone river and which had been almost completely submerged by damming of the river and creation of Carnegie Lake in 1896, was replaced with a modern concrete structure on the existing masonry piers. Two aqueducts which carried the canal over natural streams near Lambertville were similarly rebuilt, again on the existing piers and abutments.

Silt bars opposite stream entering the Feeder were removed. A section of embankment washed out by floods near South Bound Brook was replaced with an overflow spillway. At this point, in 1949, rehabilitation was suspended due to lack of appropriations. The program had so far been under the immediate direction of A. L. Trimpi, M. ASCE with H. T. Critchlow, M. ASCE as consultant. All work was scheduled and undertaken in a manner to avoid interruption of supply to existing users. Consumption at this time totaled somewhat over 6 mgd, divided between the Public Service Gas plant in Trenton, the Bakelite Company near Bound Brook, Johnson & Johnson in New Brunswick and several small users along the canal.

The work accomplished prior to suspension had restored the water flow capacity of the canal, provided adequate control at critical points and insured against complete interruption of supply such as would be caused by collapse of an aqueduct. During the suspension it was necessary under the regular maintenance program to replace all remaining lock gates with temporary timber headwalls to maintain control on intermediate levels. Thus while existing consumers were assured of a continuing supply it was not possible to realize on the restored capacity of the canal because of the certainty that any increased use would have to be curtailed when the rehabilitation program was resumed.

During the suspension of the rehabilitation program the State Highway Department enclosed approximately 1.5 miles of the main canal, from the junction of the Feeder eastward, in a twin conduit, matching in dimension and grade the Governor Moore proposal, on top of which was constructed another section of the Trenton Freeway. This work was also done without interruption of supply to consumers.

Legislation passed in the spring of 1949 authorized withdrawal of water from the canal for use, after suitable treatment by the purchaser, as a potable supply.

Applications were immediately received from the Elizabethtown Water Company for 15 mgd and from the City of New Brunswick for 7.5 mgd. The drought in the summer and fall of 1949, and the increased responsibility for maintenance of public supply, emphasized the necessity of completing the canal rehabilitation. The 1951 legislature provided an additional appropriation and the work was resumed in that year.

The overflow spillway and control structure were rebuilt at Prallsville. Concrete headwalls and cast-iron sluice gates were constructed at the Lambertville, Griggstown, Ten-Mile, South Bound Brook and Five-Mile locks, and a sheet-pile bulkhead was constructed along a constricted area in Lambertville. A new structure to provide emergency control was installed at an existing spillway above Trenton and a new overflow spillway has been incorporated in State Highway Department plans for extension of the Trenton Freeway adjacent to the canal downstream from the city. The wing-dams in the Delaware River at Bulls Island were rebuilt during the fall of 1953. Rebuilding of a few flood-discharge structures will complete the program. Rehabilitation since 1951 has been under the immediate direction of R. L. Hardman, Assoc, M. ASCE.

The designed capacity is 75 mgd delivered to the Bound Brook-New Brunswick area. Water use agreements increased during the second phase of the rehabilitation program to the present total of just over 30 mgd and action is pending on two new applications totaling 8.5 mgd.

The cost of rehabilitating the canal, including balances on hand for the few remaining projects, has amounted to $1,405,000.

In addition to use along the canal right-of-way and in the Raritan Valley, water is available to northern Middlesex and Union Counties through the existing treatment and distribution facilities of the Elizabethtown Water Company, Consolidated, through its canal intake near Bound Brook, with a capacity of 25 mgd.

A system of interconnections sponsored by the former State Water Policy Commission and installed during the World War II emergency now makes it possible to at least alleviate a water deficiency in the metropolitan area south of Newark by use of supplemental water from the Delaware and Raritan Canal, consistent of course with the capacity limitations imposed by the existing network of mains for transmission of water from one system to another.

Although at the present time the need for water in the metropolitan areas seems to be paramount, the canal stands ready to furnish a relatively abundant supply of water to adjacent areas in Hunterdon, Mercer, Somerset, and Middlesex Counties, which now appear slated for industrial development. During the extreme drought of the summer of 1953 two communities adjacent to the canal found it expedient to use canal water to supplement their dwindling supplies. As availability becomes more generally known, and considered, it is to be expected that in the very near future there will be a large increase in the demands upon canal transmission facilities. Rates are comparatively low, and will remain as low as possible consistent with maintenance costs and a reasonably short term period for reimbursement to the State Treasurer of the investment by the State of New Jersey in the rehabilitation of the canal for use as a public water supply.

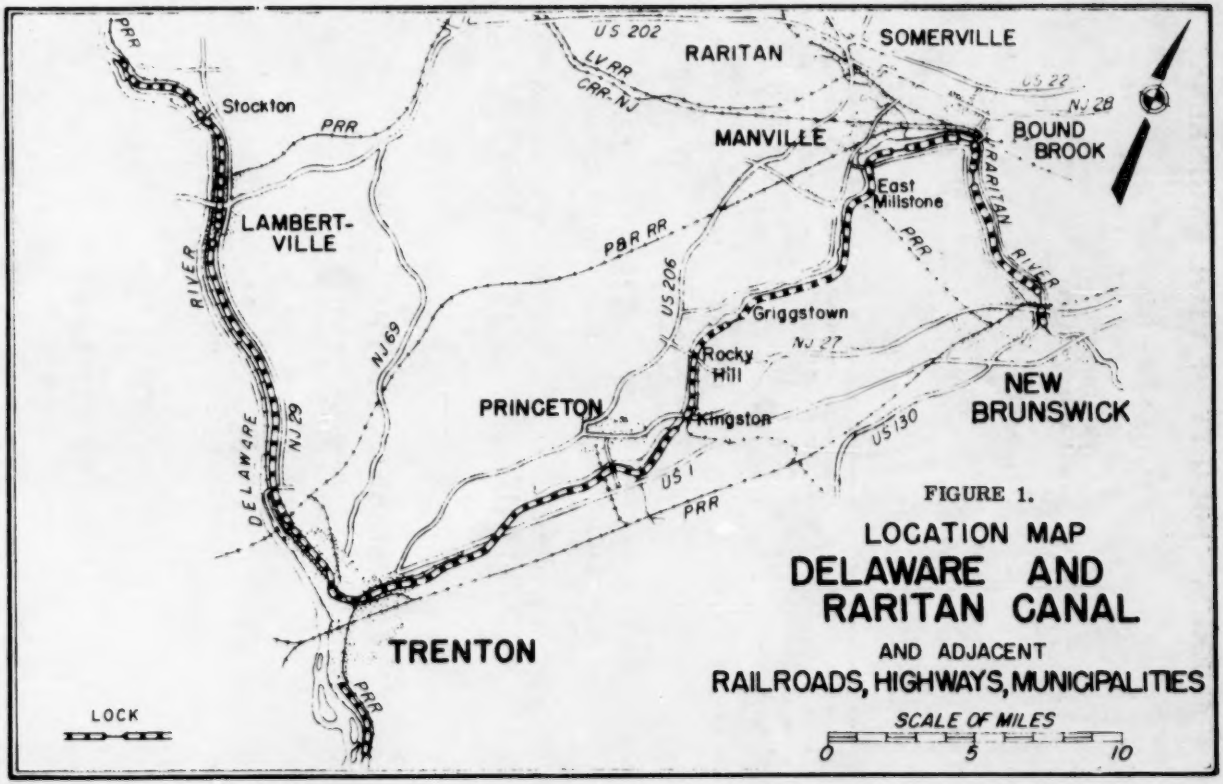

FIGURE 1.

LOCATION MAP

DELAWARE AND RARITAN CANAL

AND ADJACENT

RAILROADS, HIGHWAYS, MUNICIPALITIES

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